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RADIO SECTION

RADIO FIELD-STRENGTH MEASUREMENT

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The subject of radio field-strength measurement is of direct interest in connection with all applications of radio wave technique. Furthermore, since radiocommunication, broadcasting and, to a lesser extent, navigational aids concern many countries other than that in which the service originates, it is important to ensure that there is international agreement on the methods of measurement used and on the results obtained with the equipment available.

The practical unit of field strength is the volt per metre (conveniently divisible into millivolts per metre and microvolts per metre as required), and this implies that each metre of antenna set parallel to the electric force in the waves will have induced in it an electromotive force of one volt. The practical measurement of this e.m.f. rests, directly or indirectly, upon an observation of the current flowing in the antenna, and, as is well known, the distribution of this current depends upon the frequency in use, the dimensions and shape of the aerial and upon its surroundings.

At frequencies below about 20 Mc/s (wavelengths greater than 15 m) the methods used for field-strength measurement have been largely based on the use of a tuned closed-loop receiving aerial, connected to a suitable amplifying receiver with a suitable indicating instrument in the output circuit. The equipment incorporates a local signal generator for injecting a known comparison voltage directly into the loop aerial by one of the alternative arrangements illustrated in Fig. 1. What may be described as commercial or practical types of this equipment have been in use in very limited numbers in this country for the past 15 or 20 years, and the results obtained with them have formed the basis of such field measurements as have been made during the development of radiocommunication and broadcasting over this period. As the operating frequency is raised, technical difficulties are encountered, first in the use of a loop whose dimensions are no longer small compared with the wavelength, and secondly in arranging for the calibration of the equipment with a signal generator built into the receiver.

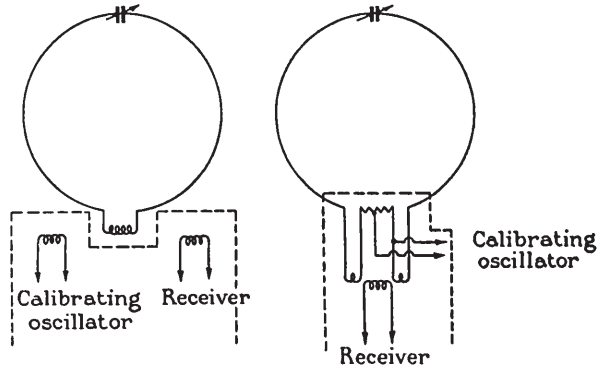

Fig. 1.—Radio field-strength measurement—alternative arrangements for calibration.

With the increasing use of higher radio frequencies an important advance in the technique of field-strength measurement was made by the introduction of a radiation field method of calibrating the apparatus. The basis of this method is the setting up of a known field strength at the position of the aerial of the measuring equipment, by means of a small transmitter of known radiation characteristics. Although originally used with loop aerials at both sending and receiving ends and with vertically polarized waves, several advantages accrue from the use of horizontally polarized radiation and straight dipole aerials, particularly as the frequency is raised from about 60 to 600 Mc/s (5–0·5 m).

The principle of the method is illustrated in Fig. 2. The symmetry and magnitude of the current in the sending dipole aerial are measured by thermo-junctions connected as shown at A_1 and A_2. By suitably choosing the heights and distance apart of the sending and receiving dipoles, the field at the latter can be calculated as the resultant of that due to the waves transmitted directly between the two dipoles, and those which are reflected from the ground. A direct comparison between this and the previous method of calibration has established the reliability of this radiation field technique for field-strength measurement at all frequencies between 30 and 600 Mc/s (10–0·5 m).

The same method can be extended to much higher frequencies

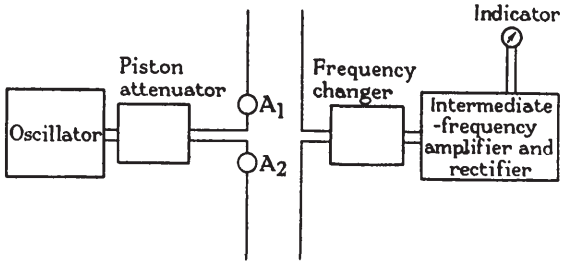

Fig. 2.—Technique of field-strength measurement at metre wavelengths—calibration by standard radiation field.

by placing the half-wavelength dipole at the focus of a paraboloidal reflector; or alternatively by using a horn termination to a short length of waveguide as the aerial system both for sending and receiving purposes. At frequencies above about 300 Mc/s it is of more direct practical use to measure power instead of current, and suitable means of doing this at frequencies up to 10 000 Mc/s (3 cm) have been developed.

Over a large part of the useful radio-frequency range, pulse-modulated fields can be measured, and this technique has been applied to the study of radar systems and the measurement of radiation from motor-car ignition systems.